BEFORE
THE PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA

DOCKET NO. 2018-318-E

In the Matter of:	)	
	)	**DIRECT TESTIMONY OF**
Application of Duke Energy Progress, LLC	)	**JAY W. OLIVER FOR**
For Adjustments in Electric Rate Schedules	)	**DUKE ENERGY PROGRESS, LLC**
and Tariffs	)	
	)	

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Jay W. Oliver. My business address is 400 South Tryon Street, Charlotte, North Carolina.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A. I am employed by Duke Energy Business Services, LLC ("DEBS") as General Manager, Grid Solutions Engineering and Technology. DEBS provides various administrative and other services to Duke Energy Progress, LLC ("DE Progress" or the "Company") and other affiliated companies of Duke Energy Corporation ("Duke Energy").

Q. PLEASE BRIEFLY DESCRIBE YOUR DUTIES AS GENERAL MANAGER, GRID SOLUTIONS ENGINEERING AND TECHNOLGY FOR DUKE ENERGY.

A. My duties and responsibilities include planning for the grid and related system modernization efforts across Duke Energy.

Q. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I have a Bachelor of Science degree in Electrical Engineering from the Georgia Institute of Technology and a Master's degree in Business Administration from the University of South Florida. I am a licensed Electrical Engineer and a registered Professional Engineer in Florida. From 25 years working in the electric utility business, I have experience in electric transmission, distribution, and Information Technology and Telecommunications systems that support utility transmission and distribution

networks. I began working at Duke Energy in 1996, joining one of its predecessor companies, Florida Progress. Over the past 10 years I have held the positions of Region General Manager, Director Distribution Services, Major Projects Manager, and Director, Grid Automation. I have been in my current role since January 2017.

Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THIS COMMISSION OR ANY OTHER REGULATORY BODIES?

A. Yes, I testified before the North Carolina Utilities Commission ("NCUC") in DE Progress' 2013 Demand Side Management/Energy Efficiency proceeding in Docket No. E-2, Sub 1030 and in DE Progress' 2014 Fuel Charge Adjustment proceeding in Docket No. E-2, Sub 1045.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I am testifying as an expert witness in this case in two separate capacities. In my capacity as the witness supporting ongoing operations, I describe and support the existing DE Progress' transmission and distribution ("T&D") system; the operation and performance of the T&D system; and the costs necessary to operate and maintain it. In my capacity as the witness supporting DE Progress' Grid Improvement Plan for South Carolina, I describe trends affecting the electric grid and how we plan to address those growing challenges through our Grid Improvement Plan.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. Following the introduction above, my testimony is organized as follows:

I. First, I will provide a description of DE Progress' T&D system, describing notable investments made in our system since the Company's last rate case in South Carolina and an overview of the operational performance of the Company's T&D system.

II. Second, I will describe the trends affecting the electric grid in the 21st century environment, how we analyze those issues, and how they will impact our grid if addressed through traditional means alone.

III. Third, I will describe the tools available to address the trends, explain how programs in the Grid Improvement Plan are evaluated, and present our overarching Plan which addresses the issues in a stakeholder-informed manner.

IV. And finally, I will provide a three-year work plan for our grid improvements with defined projects for Commission approval and the grid improvement work to date, which is included in this case. I note we are also requesting a corresponding rate recovery plan in this case as further explained by Witnesses Ghartey-Tagoe, Bateman, and Wheeler.

Q. ARE YOU PROVIDING ANY EXHIBITS WITH YOUR TESTIMONY?

A. Yes, I have attached 12 total exhibits, described below:

Exhibit 1: Maintain Base Transmission and Distribution System Work- describing what work the Company does as base-level maintenance work;

Exhibit 2: Megatrends Impacting South Carolina- detailing key trends relevant to the Grid Improvement Program;

Exhibit 3: South Carolina Grid Improvement Plan Implications-discussing how megatrends are impacting operations in South Carolina;

Exhibit 4: South Carolina Grid Improvement Plan Program Summaries-describing the projects and programs in the Grid Improvement Plan;

Exhibit 5: Portfolio Prioritization Methodology-detailing how the Grid Improvement Plan is prioritized;

Exhibit 6: Cost/Benefit and Cost Effectiveness Evaluation Execution Protocol-showing how the Company evaluates potential grid improvement projects;

Exhibit 7: South Carolina Cost Benefit Analysis-Program Level-providing examples of program-level cost/benefit analyses;

Exhibit 8: South Carolina Cost Benefit Analysis-Project Level-providing examples of project-level cost/benefit analyses;

Exhibit 9: South Carolina Grid Improvement Plan-detailing the work contained in the Grid Improvement Plan;

Exhibit 10: September 6, 2018 South Carolina Grid Improvement Plan Workshop Report-containing the results of the Company's first South Carolina stakeholder workshop;

Exhibit 11: October 10, 2018 South Carolina Grid Improvement Plan Workshop Pre-Read-containing materials provided to stakeholders prior to the October 10, 2018 workshop; and

Exhibit 12: October 10, 2018 South Carolina Grid Improvement Plan Workshop Report-containing the results of the Company's second South Carolina stakeholder workshop;

Q. **DO THESE EXHIBITS ONLY CONTAIN INFORMATION ABOUT DE PROGRESS?**

A. No. Duke Energy has created a plan for the grid in South Carolina, and that includes both DE Progress and DE Carolinas. All information is shown in a utility specific manner. I believe it's important to show these plans jointly as we think of the needs of customers in the State. Moreover, I believe it facilitates better discussions among parties and entities who have interest in both service territories to see the material presented together.

Q. PLEASE PROVIDE AN OVERVIEW OF YOUR OPERATIONAL TESTIMONY.

A. DE Progress reliably serves approximately 170,000 customers in South Carolina through a multi-state electric system that includes 6,300 miles of transmission lines, more than 25,000 miles of underground distribution lines, and approximately 500 substations. For the DE Progress' distribution system, approximately 1,200 distribution line miles and 8,398 transformers were added over the last two years.

As part of the Company's commitment to reliably serve customers and continually improve operations, DE Progress has invested $1.2 billion in electric plant in service for T&D infrastructure over the last two years. Maintenance work and reliability improvements included replacement of

deteriorated wooden poles, replacement of obsolete line and substation equipment, and customer-driven line and substation expansions.

DE Progress also maintains a comprehensive vegetation management program across the state that works to proactively maintain trees both within and without the rights-of-way on regular cycles. This work seeks to improve overall reliability, harden the grid against severe weather and reduce the impact of vegetation which currently accounts for 20 to 25 percent of outages across the system.

Overall, the DE Progress grid is reliable and well-maintained. While the Company has worked hard to maintain the system well and reliably meet the needs of customers, we also increasingly understand more must be done to improve the state's energy infrastructure to meet the energy challenges and opportunities that lie ahead.

Q. PLEASE PROVIDE A SUMMARY OF THE COMPANY'S GRID IMPROVEMENT PLAN.

A. Through a comprehensive assessment of the state of the grid and influences affecting the region, the Company has identified several emerging trends, which I refer to in my testimony as "megatrends," that drive the need to make improvements now to the electric system in South Carolina.

South Carolina is a growing state, especially in urban and suburban areas, where residential and business growth is becoming concentrated. With that growth, comes growing consumer expectations for more interaction with their electric company and more control over the way they use electricity. And

along with that, a higher reliance on "perfect power" – power that stays on and when an outage does occur, is restored faster than ever.

As recent events have reinforced, the Company must be ready for severe weather before it strikes and reduce the impact of storms that are worsening in frequency and intensity. The Company must be vigilant and prepare now for the very real threat of cyber and physical attacks. And as renewable energy and distributed energy technologies like solar energy, battery storage, micro-grids and electric vehicles become more affordable and accessible, it is important to take steps now to ready the grid to support the growth of these technologies that are important to the state's energy future.

All of these influences come at a time of increasing environmental commitments and compliance requirements that drive change for the Company and the industry. But they also come at a time when grid technology is rapidly advancing, and becoming increasingly intelligent, providing new tools and new opportunities to improve the way the Company serves customers.

To deliver on customer expectations and address these trends, the Company believes that we must do more than maintain the power grid; the Company must make the appropriate investments to transform it, making strategic, data-driven improvements to power a smart-thinking grid that is more reliable, more resilient, and built to meet the energy needs of customers today and into the future.

Duke Energy Progress' SC grid improvement plan was developed through a comprehensive analysis of the trends affecting our business in the state and the tools to best address those trends in a cost-effective and timely manner. The grid improvement plan is built upon strategic, data-driven investments to improve reliability to avoid outages and speed restoration; harden the grid to protect against cyber and physical threats; expand solar and other innovative technologies across a two-way, smart-thinking grid; and give customers more options and control over their energy use and tools to save money. These improvements will provide benefits now and in the years to come.

Components of Duke Energy's grid improvement plan operationally fall into one of three categories:

- Compliance-driven programs that protect the grid;
- Programs that leverage advanced technologies to modernize the grid; and
- Projects and programs that work to optimize the customer's experience.

1. Protect the grid

More must be done to strengthen the grid and mitigate the impact of major storm events, as well as to harden and defend the grid against critical physical and cybersecurity risks. Compliance requirements in these areas are also driving improvements across the state. Examples of the company's multi-layered improvements designed to protect the grid include:

- Installing protective devices to limit access to critical systems and minimize outages from physical or cyber attack; and

- Relocating, raising or reinforcing equipment in flood-prone areas.

2. Modernize the grid

Technology is rapidly changing, and more must be done to incorporate and anticipate new technologies to better serve a growing state. Customers – more than ever – expect more options, greater reliability, and value. Self-selecting billing and payment dates, scheduling appointments, accessing real-time usage data and information updates when outages occur are all examples of basic services consumers expect but require technology to deliver. And increasingly, consumers want access to information about how they use energy and tools to take control of that energy use and save money.

Examples of improvements designed to modernize the grid include:

- Smart meters to provide improved customer usage data, enhanced outage detection to improve customer service, and access to increased customer options to manage energy use and save money.
- Distribution automation and dispatch tools to improve power quality and reliability and support the growth of distributed energy resources and customer-owned technologies.
- Integrated system operations planning, automation, and system intelligence to prepare the grid for increased distributed resources and the dynamic power flows that these technologies bring.

3. Optimize the customer experience

Customers want and deserve a better experience, built on the technology needed to meet their changing energy needs. To meet these

expectations, we must optimize the total customer experience and transform the grid to prepare it for the energy opportunities that lie ahead.

Optimization upgrades in the grid improvement plan include:

- A self-optimizing, smart-thinking grid that anticipates outages and automatically reroutes service to keep power on for customers. Self-optimizing technology can reduce outage impacts on customers by as much as 75 percent. It will also provide the foundation for the two-way power flows needed to support more rooftop solar, battery storage, electric vehicles, and microgrids – technologies that will increasingly power the lives of customers.
- Expanded energy storage capabilities and infrastructure, which will help to power self-optimizing technologies in areas where building a redundant power line may not be feasible.
- Electric vehicle charging infrastructure improvements to expand transportation options for customers across the state.
- Voltage optimization and distribution of power to customers to improve reliability, increase system intelligence and support the two-way power flow needed to grow distributed resources.
- Upgrading utility poles, transformers, and other grid equipment, as well as using advanced data to strategically underground the most vulnerable, outage-prone lines on the distribution system.

The Company has constructed the Grid Improvement Plan, with stakeholder feedback, to address the risks and opportunities that the analysis

revealed. The Plan seeks to balance the pace, scope, location, and timing of our work to address a diverse set of customer and stakeholder needs. As we built the Grid Improvement Plan proposed in this case, the Company has also kept the needs of our rural and low-income customers in mind and sought to develop a strategy that maximizes benefits to customers and the state, while keeping costs as low as possible.

In developing this informed plan, the Company layered our data analytics with significant input from customers, customer and advocacy groups, and other stakeholders. Finding common ground on important topics that affect all of our customers is very important to Duke Energy. The Company realizes that plans that look good on paper may not translate the way we think they will when executed in the real world. That is why the Company has sought out customer and stakeholder perspectives, including multiple stakeholder workshops, as part of the process before presenting this grid improvement plan.

I am presenting a three-year South Carolina Grid Improvement Plan that I believe can effectively serve customers now and in the years ahead. The Company's application requests that the Commission approve our Grid Improvement Plan as detailed in Exhibit 9. Exhibit 9 shows numbers for South Carolina based on budgeting methods, which may vary from ratemaking allocations. The details regarding the Company's proposal to recover the costs related to the Grid Improvement Plan are included in Witness Bateman's testimony. The proposed system investment of $168 million and $329 million respectively for 2019 and 2020 can be seen on Bateman Exhibit 3 Page 6, and the

South Carolina Retail allocated portion for rate making of the proposed system spend is $20 million and $41 million, which is also on Bateman Exhibit 3 Page 6.

The Grid Improvement Plan is about making smart choices now to make the state's energy grid more reliable, more secure, and ready for the energy opportunities that lie ahead. Just as the past decade modernized the way Duke Energy generates electricity, the years ahead will transform the way we deliver electricity and serve customers. With each improvement, we can improve the overall reliability of the grid and enhance service for every customer, regardless of the type of customer and where they are located.

I. DE PROGRESS' T&D SYSTEM OVERVIEW AND INVESTMENTS SINCE THE COMPANY'S LAST RATE CASE IN SOUTH CAROLINA

Q. PLEASE GENERALLY DESCRIBE DE PROGRESS' T&D SYSTEM IN THE CAROLINAS.

A. DE Progress' T&D system delivers electric service to approximately 1.6 million retail customers located throughout a 32,000-square mile service area in eastern North Carolina, eastern South Carolina, and western North Carolina. Approximately 170,000 of the Company's retail customers are in South Carolina. In addition to its retail customers, DE Progress also sells electricity at wholesale rates to municipal, cooperative, and other investor-owned utilities.

DE Progress operates as a single balancing authority with two balancing authority areas to economically manage the Company's integrated electric delivery systems in both North Carolina and South Carolina,

collectively. This system interconnects with seven other balancing authority areas[1] and includes 6,300 circuit miles of transmission lines. The distribution system is comprised of approximately 44,700 miles of overhead distribution lines and 25,100 miles of underground distribution lines. DE Progress' T&D system also includes 128 transmission substations, and 361 distribution and industrial substations with a combined capacity of approximately 50 million KVA. In addition to power lines and substations, the system includes various other equipment and facilities such as control rooms, computers, poles, transformers, regulators, capacitors, street lights, meters, and protective relays. Together, these assets provide the Company considerable operational flexibility with its T&D system and allow DE Progress to provide safe, reliable, and economical power to the Company's customers in South Carolina.

Q. HAS DE PROGRESS' T&D SYSTEM GROWN SINCE THE LAST RATE CASE?

A. Yes, the T&D system has expanded over time to ensure adequate system voltage and capacity, based on projected system loading, and contingency requirements related to providing safe and reliable service to our customers. Transmission system growth has also occurred because of new generation and/or decommissioning of existing generation assets. For the DE Progress distribution system, approximately 1,200 distribution line miles and 8,398

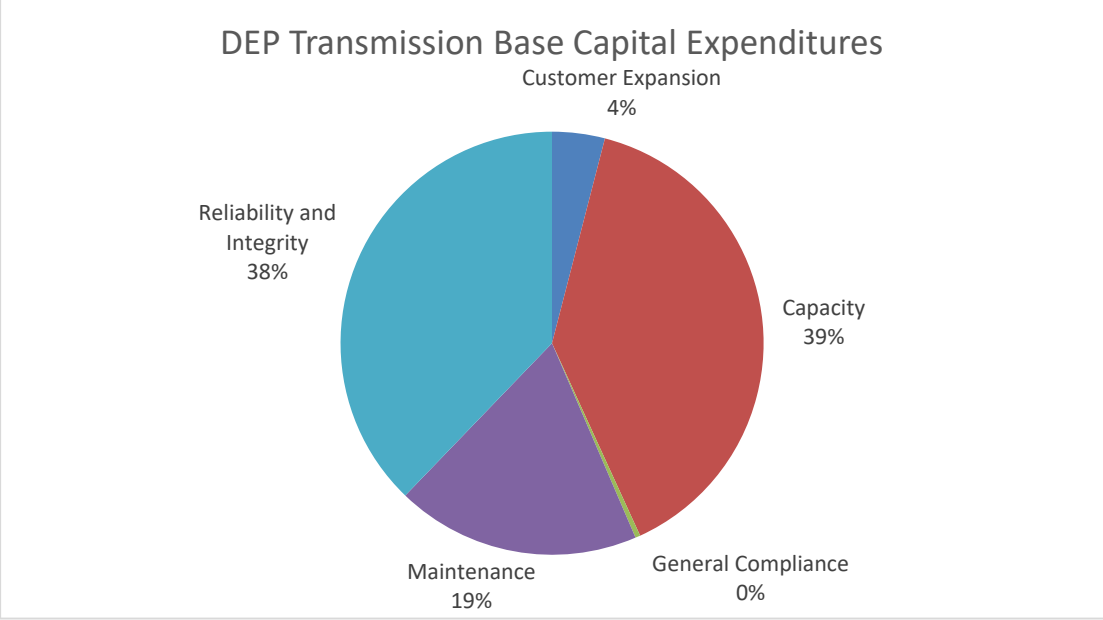
[1] Dominion, AEP, DE Carolinas, Santee Cooper, Tennessee Valley Authority, Cube Energy (Previously Yadkin Alcoa), and SC Electric & Gas.

transformers were added over the last two years. Overall, we have added approximately $1.2 billion to electric plant in service for T&D infrastructure in the last two years.

Q. CAN YOU PROVIDE MORE DETAIL ABOUT THE ADDITIONAL INVESTMENTS THE COMPANY HAS MADE IN ITS T&D SYSTEM SINCE THE LAST RATE CASE?

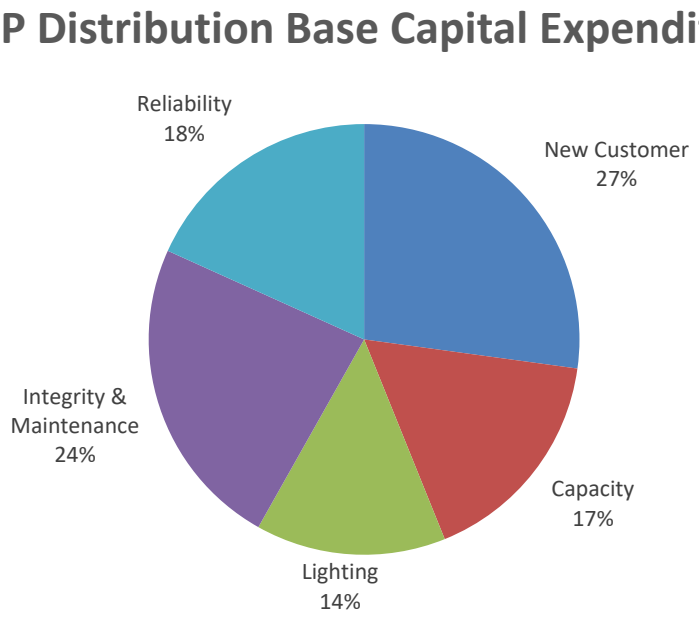
A. Additional investments in the Company's T&D system have been made to provide capacity to serve system growth, ensure adequate system voltage, support transmission-related infrastructure for both new generation and decommissioning of generation, and improve certain aspects of system reliability. Over the past two years, more than $0.3 billion was invested in the transmission system and approximately $0.9 billion in the distribution system.

The chart below illustrates the major categories of the transmission system capital investment over the last two years.



In the transmission system, approximately 39 percent of investment was driven by capacity requirements to serve load and to meet the North American Reliability Council ("NERC") Planning Standards and generation. Approximately 38 percent of investment was driven by standard reliability and integrity improvement programs. Approximately 19 percent of investment was driven by maintenance programs, including the replacement of deteriorated wood poles and replacement of obsolete substation and line equipment. Approximately 4 percent of the investment was driven by customer expansion work which includes new customer projects as well as line and substation upgrades driven by transmission service requests.

The chart below illustrates the major categories of the distribution system and the capital expenditures over the last two years.



South Carolina continues to be a desirable place to live and work, as evidenced by the more than 400 new retail customer meters added during the

12-month period ending December 31, 2017. Typically, new customers locate in areas where DE Progress must build new distribution facilities to serve them, including expenses for new customer connections or capacity work needed to support overall load growth. Approximately 58 percent of the Company's distribution expenditures over the last two years are for load expansion-related work, including serving new customers, lighting installations, and additional capacity.

Approximately 42 percent of the remaining investments on the Company's system relate to base-level work around standard reliability and integrity programs that address safety and environmental requirements; and maintenance including service restoration.

Q. CAN YOU PROVIDE DETAIL ABOUT HOW THE COMPANY DETERMINES WHAT IS TO BE CATEGORIZED AS BASE T&D SPENDING?

A. Yes. The type and scope of transmission and distribution "Maintain Base" work that we perform on our system can generally be thought about as a product of the following equation: [Safety Requirements] + [Load Service Requirements] + [Reliability Requirements] + [Environmental Requirements] = Type and Scope of Work. What work goes into the four elements of this equation may be dictated by mandatory external requirements (such as laws, codes, and regulations), internal company standards, national industry standards, or a combination of these requirements and standards, but any base-level work done on the transmission and distribution system fits into one of

these four categories. In Exhibit 1 to my testimony, I have provided more detail as to what general work fits into each one of the categories.

Q. IN YOUR OPINION, ARE ALL THE T&D FACILITIES INCLUDED IN DE PROGRESS' BASE RATE REQUEST USED AND USEFUL IN PROVIDING SERVICE TO DE PROGRESS' RETAIL ELECTRIC CUSTOMERS IN SOUTH CAROLINA?

A. Yes. Including the projects that will be completed prior to the evidentiary hearing in this case, all of the reasonable and prudent additions to DE Progress' T&D system requested for recovery in base rates are used and useful to its approximately 170,000 customers in South Carolina.

Q. HAVE THE T&D INVESTMENTS THAT THE COMPANY HAS MADE ALLOWED IT TO MEET ITS OPERATIONAL PERFORMANCE AND CUSTOMER SATISFACTION GOALS?

A. Yes they have, but as I discuss later in my testimony, we are seeing unfavorable trends that are making these goals more challenging to meet. DE Progress' principal goal is to deliver safe and reliable electric service at reasonable prices. We measure this principal goal based on customer satisfaction, safety, and reliability of the Company's T&D systems, while responsibly managing operational and capital expenditures for the benefit of our customers.

Q. PLEASE EXPLAIN THE METRICS THE COMPANY USES TO MEASURE THE EFFECTIVENESS OF ITS T&D OPERATIONS.

A. DE Progress utilizes several industry-standard metrics to assess the overall effectiveness of its T&D operations. These metrics include reliability indices to measure the performance of the transmission and distribution system and customer satisfaction scores to determine how well the Company is meeting the needs of its customers.

The Company uses several industry-accepted transmission and distribution performance metrics as defined in IEEE Standard 1366-2012:

- **System Average Interruption Frequency Index ("SAIFI")** is a ratio that indicates how often the average customer experiences a sustained interruption over a predefined period of time.
- **System Average Interruption Duration Index ("SAIDI")** is a ratio that indicates the total duration of interruption for the average customer during a predefined period of time.
- **Customers Experiencing Multiple Interruptions ("CEMI 6")** is a measure of the percentage of customers who experience six or more outages in a 12-month period.

Q. HOW HAS DE PROGRESS' TRANSMISSION AND DISTRIBUTION SYSTEM PERFORMED UNDER THESE METRICS?

A. Our system has performed well, and we have continued to provide safe, reliable, and affordable electric service to our customers. Over the past ten years, however, both SAIFI and SAIDI show an unfavorable trend, with the

frequency and duration of outages increasing across the DE Progress system despite our efforts and investments that I have discussed previously. Graphs displaying the trends for these metrics are set forth below:

Figure 1 – Duke Energy Progress' Historic System Average Interruption Frequency Index (SAIFI)

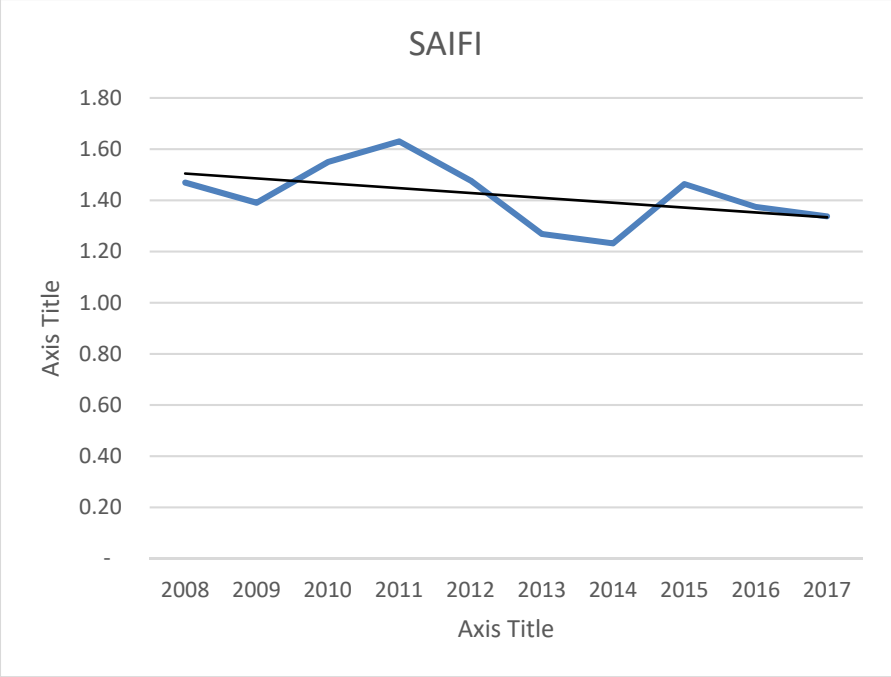
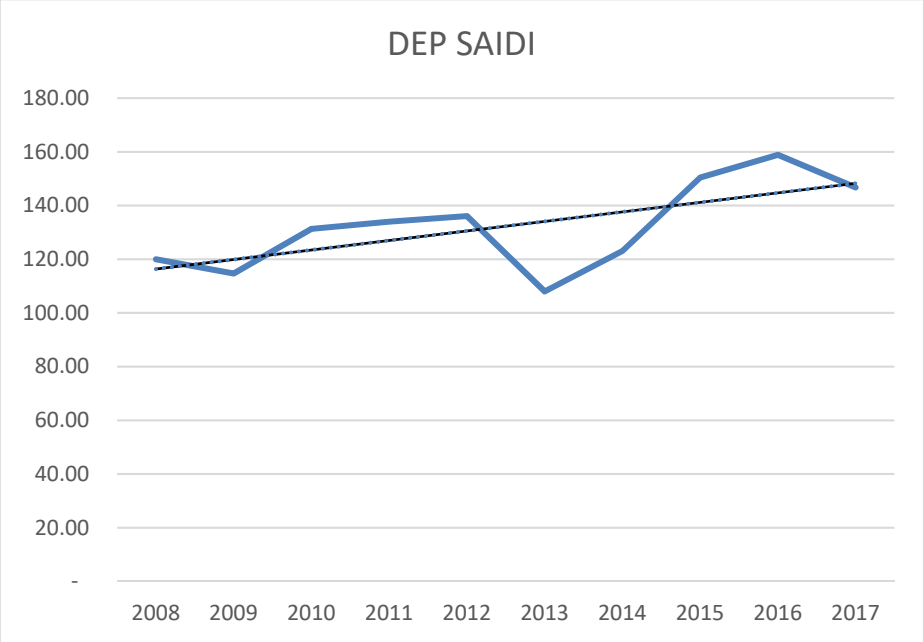


Figure 2 – Duke Energy Progress' Historic System Average Interruption Duration Index (SAIDI)



In summary, reliability performance is worsening due to the increase in the number of outage events. While investments have been made to reduce customer impacts, the worsening in SAIDI is due to the increase in the number of outage events. There are several factors and trends, which I address later in my testimony, contributing to the worsening reliability trends.

Q. PLEASE EXPLAIN THE COMPANY'S APPROACH TO DISTRIBUTION VEGETATION MANAGEMNT AND DESCRIBE ANY CHANGES THE COMPANY HAS MADE TO ITS APPROACH SINCE THE LAST RATE CASE.

A. Vegetation management is a critical component of the Company's power delivery operations and the continued effort to drive performance for customers' benefit. DE Progress uses a reliability-based prioritization model

to drive its routine integrated vegetation management program. In addition to routine circuit maintenance, there are four other very important components to the Company's overall vegetation management approach.

(1) Herbicide Program – The purpose of the Annual Herbicide Program is to control re-growth of incompatible vegetation within the right-of-way "floor" in non-landscaped areas;

(2) Hazard Tree Program – Implemented in 2014, this program is designed to identify/remove dead, dying, and diseased trees primarily located outside of the existing Distribution right-of-way;

(3) Reactive Program – This program is designed to address customer initiated requests as well as vegetation related power quality issues identified as part of outage follow-up investigations; and

(4) Disciplined vegetation management outage follow-up process tied to a formal internal reliability review process.

The Company's reliability-based vegetation management program aligns with the program used by Duke Energy Carolinas, LLC ("DE Carolinas") which has produced long-term positive results.

In 2015, DE Progress completed a Distribution Vegetation Species Frequency and Re-Growth Study to help determine an optimum vegetation maintenance cycle. The results of the study recommended an optimal trim cycle for non-urban circuit miles of seven years. In 2018, the Vegetation Management Plan implemented the seven-year trim cycle for non-urban miles,

which had previously been set at six years. The study did not result in a change from the three-year trim cycle set for urban miles.

Q. DOES THE COMPANY PROPOSE AN INCREASE IN FUNDING FOR VEGETATION MANAGEMENT?

A. Yes. The Company is requesting a $0.3 million increase in funding for the Distribution Vegetation Management program. The increase is driven by increases in contract labor rates that took effect in 2017 and 2018 of 4 and 16 percent respectively, partially offset by the change to a seven-year trim cycle for non-urban miles. The increases in contract labor rates are driven by a tightening labor market and increased safety standards, so the Company expects to see further cost increases in the coming years.

Q. WILL THE COMPANY'S VEGETATION MANAGEMENT PLAN CURE ALL ADVERSE SYSTEM IMPACTS THAT THE COMPANY HAS SEEN DEVELOP IN THE RECENT PAST?

A. No. Vegetation events account for 20 to 25 percent of all outage events. It is important to understand that approximately 75 to 80 percent of all outages on the grid are due to other causes, such as equipment failure, public accidents, and environmental factors. In addition, for the 20 to 25 percent of events that are vegetation related, only 50 percent of these are related to vegetation inside the right-of-way where the Company can perform vegetation management. The other 50 percent occur due to trees outside the right of way that will fall into or otherwise impact distribution lines, and the Company does not have the ability to perform vegetation management on these trees that are located

on private property. For the outages that occur because of trees inside the right-of-way, even a perfectly executed integrated vegetation management plan will not bring this number down to zero but instead will only help minimize vegetation outages.

Keeping these facts in mind, the Company engaged in the Tree Growth Study that I previously discussed to determine the optimal right-of-way trimming cycles for our geographical areas. Trimming more often than these now pre-determined, optimal cycles will only provide diminishing returns and would not be cost effective. Drastic clear cutting and going onto customer property and cutting down live trees via condemnation or negotiating with customers for rights on their property is also impractical and not cost effective. Instead, programs such as targeted undergrounding, which will be discussed in more detail later in my testimony, can be effectively used to address vegetation outages caused by trees outside of the right-of-way, where the base vegetation plan stops.

II. NEW TRENDS AFFECTING THE SOUTH CAROLINA ELECTRIC GRID

Q. HAVING DESCRIBED THE EXISTING T&D SYSTEM AND HOW THE COMPANY MAINTAINS ITS BASE-LEVEL OF SYSTEM PERFORMANCE, WOULD YOU PLEASE PROVIDE DETAIL ON THE SOUTH CAROLINA GRID IMPROVEMENT PLAN?

A. Yes. There are seven major trends that we call "Megatrends," impacting Duke Energy's grid in South Carolina. The trends are summarized below and are discussed individually in detail in Exhibit 2:

1. Population and business growth continues in South Carolina, and is heavily concentrated in urban and suburban areas;
2. Technology is advancing at a rapid rate in the areas of renewables and distributed energy resources (DERs), which means there are new types of load and resources impacting the grid;
3. Technology is also advancing rapidly within the devices and systems that operate and manage the T&D grids, offering new capabilities and requiring new functionalities;
4. Customer expectations and use of the grid are very different from generations past;
5. There has been an increase in environmental commitments from the international to local level in DE Progress' service territory;
6. The number, severity and impact of weather events on DE Progress' customers has been increasing significantly; and

7. The threat of physical and cyber attacks on grid infrastructure is more sophisticated and is on the rise.

These seven Megatrends are the factors that are driving the need for the Company to have a Grid Improvement Plan that goes beyond the work that the Company performs to maintain base-level operations.

Q. HOW DID THE COMPANY IDENTIFY AND VALIDATE THAT THESE MEGATRENDS EXIST?

A. Over the past several years, we have seen these Megatrends develop in the day-to-day operation of our business. Some of these Megatrends, such as the increased number and increased sophistication of attempted cyber attacks on our system, are easily identified and are evident as they happen. Other changes, such as the way our customers are using and depending on the power we provide them, are more subtle and can be harder to identify. With all these Megatrends, however, our first step was to inventory facts and information that we saw from operating our grid that appeared different than the facts and information we had seen in the previous years of operation.

Once we had conducted the aforementioned inventory, we then looked across the industry to see if other utilities and industry stakeholders were seeing the same Megatrends developing in their operations. As we suspected, the same new Megatrends that we are seeing develop in South Carolina are also being seen throughout the industry.

Q. HOW DID THE COMPANY GO ABOUT ESTABLISHING THAT THE FACTS AND INFORMATION IT WAS SEEING ROSE TO THE LEVEL OF ESTABLISHING WHAT YOU HAVE CALLED MEGATRENDS?

A. During this process of identifying and validating the Megatrends, we collected objective information from our own operations in South Carolina as well as from our companies that function in other jurisdictions. From South Carolina to Florida, and in Kentucky, Ohio, Indiana, and North Carolina, we began to see commonality in the facts and information that evidenced the existence of these Megatrends. From there, we then began to look at objective national information that non-Duke companies and industry stakeholders were sharing publicly. That information also confirmed the existence and validity of the megatrends. In Exhibit 2 to my testimony, I have included summary data, citations, and information that the Company collected on each Megatrend. The 2016 South Carolina State Energy Plan also noted the existence of many of these trends, as the following passage reveals:

> "In developing this State Energy Plan, it has become very evident that electric utilities are facing expanding customer expectations, increasing environmental regulation, and new technologies that have to be integrated seamlessly into the grid. The grid of the rapidly approaching future will function in ways never imagined when the original wires were installed. If South Carolina is to participate in the innovation coming to fruition in the electric sector — such as distributed energy resources like solar panels, wind turbines, electric

vehicles, and microgrids — then the state will require an advanced, integrated grid to manage and optimize the increasingly dynamic flow of electricity."[2]

Q. WHAT WAS THE NEXT STEP IN THE DEVELOPMENT OF THE GRID IMPROVEMENT PLAN AFTER THE COMPANY IDENTIFED AND VALIDATED THE EXISTENCE OF THE MEGATRENDS?

A. Once we found that the Megatrends we were seeing in South Carolina were valid and that those Megatrends were also impacting utilities across the nation, we then had to analyze whether the Megatrends mattered. Said another way, the Company had to evaluate whether any or all of the Megatrends caused any problems or issues that warranted work in South Carolina that was above and beyond the Company's base-level T&D plan that I have previously discussed.

Q. DID THE COMPANY PERFORM THIS EVALUATION?

A. Yes, we did. To determine whether one or more of these Megatrends warranted the Company to develop an incremental Grid Improvement Plan for the state, the Company first listed out all the implications that the Megatrends would logically and objectively have on providing our customers safe, reliable, satisfying, and affordable electric service. For example, one of the facts we discovered was that customers with higher usage and higher expectations for power quality and reliability were beginning to concentrate

[2] http://www.energy.sc.gov/files/Energy%20Plan%20Appendicies%2003.02.2018.pdf, 2016 South Carolina State Energy Plan, Appendices, page 121.

more and more in urban and suburban areas such as Greenville. Given this seemingly undeniable fact, we had to ask the question of what this fact means to our T&D operations. Capital demands to meet system expansion for these customers using a business as usual approach (i.e. adding capacity) in high growth areas can undermine investment in rural areas of the state causing disparity between customer demographics and geography. In Exhibit 3 to my testimony, I have included our evaluations of these Megatrends and what implications they will have on the Company's grid operations.

III. GRID IMPROVEMENT PLAN

Q. ONCE THE COMPANY INDENTIFED AND VALIDATED THE MEGATRENDS AND THE IMPACTS THEY ARE HAVING NOW AND THAT THEY WILL HAVE ON THE GRID IN THE FUTURE, WHAT PROCESS DID THE COMPANY USE TO PUT ALL THIS INFORMATION INTO A GRID IMPROVEMENT PLAN?

A. At this point in our evaluation, the Company took the following overall steps to develop a proactive plan that addresses impacts of the Megatrends:

1. Identified "tools" (i.e. utility projects and programs) available to address the Megatrend impacts. In Exhibit 4, I have included detailed descriptions of the programs and projects that the Company considered as "tools" to address Megatrend implications;
2. Determined constraints that impacted the creation of the plan such as equipment availability, manpower limitations, available time and

schedule, any applicable prescriptive requirements, interplay with base-level work needs, and price impact;

3. Selected "tools" to use in the plan in an iterative process that built up from a foundation of protecting the grid first and foremost; establishing foundational, system-level programs that are needed for all aspects of operations and that impact all customers next; and then focusing on projects and programs that help address the most number of Megatrend implications for the best value to customers. We called this phase of the plan development "protect," "modernize," and "optimize," and I have included a series of graphics that help to explain this process as Exhibit 5 to my testimony; and

4. Developed a final, comprehensive Grid Improvement Plan that efficiently organizes the work to be completed based on where, when and how much is appropriate.

Q. YOU MENTIONED THAT THE FIRST STEP IN DEVELOPING THE GRID IMPROVEMENT PLAN WAS IDENTIFYING TOOLS THE COMPANY HAS TO ADDRESS THE MEGATRENDS. CAN YOU PROVIDE MORE DETAIL ON THIS PHASE OF THE PLAN DEVELOPMENT?

A. Yes. The programs and projects that are available to the Company to help address the implications of the Megatrends in South Carolina can be grouped into three basic categories based on how the Company brings those programs into its plan. These three categories are (1) compliance-driven programs that

protect the grid, (2) rapid technology advancement programs that modernize the grid, and (3) various other projects and programs that work independently or together with other programs to optimize our customers' experience. I will further describe those categorizations below.

Q. WHAT CONSTITUTES COMPLIANCE-DRIVEN WORK THAT IS DESIGNED TO PROTECT THE GRID?

A. Compliance-driven programs in the Grid Improvement Plan are efforts which need to be completed to reduce physical and cyber threats to the grid. These programs may be necessitated by: an external law, rule, or regulation applicable to the company that requires the work; a binding legal obligation such as a contract, agency order, or other legal document that compels the work; or Operations Council approval of the work as being critical and imperative to the Company's operations. To qualify for inclusion in the Grid Improvement Plan, work in this category is limited to rapidly evolving threats to the grid that outpace the scope and timing of standard compliance work done in our base-level operations. The type of work to address these concerns includes applying physical and cyber protections to transmission substations and distribution assets that are not yet covered under mandatory federal regulations such as special protective fencing and barricades to help minimize the threat of gunshot attacks to equipment, intruder sabotage, and vehicle attacks to critical equipment, and installing tamper alarms and protective cyber "blocking devices" on electronic distribution equipment that are

susceptible to hacking by a cybercriminal on our distribution assets in the field.

Q. HOW DO YOU EVALUATE COMPLIANCE-DRIVEN PROGRAMS?

A. When evaluating compliance-driven programs as part of the Grid Improvement Plan, we first focus on work that has a prescriptive mandate that dictates how, when, or where the work must be done. For example, if a federal regulation states that we must take certain activity on a certain set of grid assets at a certain time, we necessarily put that work into our plan first given that the Company has little discretion to do otherwise. Once that work is incorporated into the plan, the Company then focuses on non-prescriptive work that poses the highest risk to the grid and then continues to incorporate grid protection work into the plan on a risk-advised basis, taking plan constraints into consideration. Since this grid protection work must be done, the Company does not evaluate these compliance-based programs with cost-benefit analyses, but instead takes measures to ensure that this work is done in a cost-effective manner. In Exhibit 6 to my testimony, I have included a "gating tool" that the Company uses to determine how to properly evaluate the costs and benefits of all the work in the Grid Improvement Plan. Compliance Driven Programs include the following types of work and activities: electronic access blocking and gating restrictions on computerized systems and equipment; cyber defense computer programs and applications; physical access restrictions and protective devices to substations and critical equipment; and electromagnetic pulse protections on certain critical assets.

Q. WHAT CONSTITUTES A RAPID TECHNOLOGY ADVANCEMENT PROGRAM THAT YOU DESCRIBED AS THE SECOND "BUCKET" OF WORK IN THE GRID IMPROVEMENT PLAN?

A. Rapid technology advancement work that is needed to modernize the grid consists of equipment, software, hardware, operating systems, and/or accepted system operating practice that has advanced at an atypical pace causing the need for rapid and sometimes frequent changes within the utility at a system deployment level. Work in this category is usually related to system communication, automation, and intelligence and must be executed at a deliberate pace while ensuring not to deploy new technology before it has reached maturity. While not technically compliance activities, work in this category is essential for modern system operations. The State Energy Plan anticipated the need for "communications among grid equipment and with centralized systems" to address the challenges of rapid advancement in technology and grid needs.[3] Rapid Technology Advancement Programs include the following types of work and activities: deploying new system-wide communications devices so that the transmission and distribution system can communicate back to us and with each other, replacing pneumonic and manually actuating equipment with modern electronic and intelligent equipment that is self-actuating and self-correcting, and installing advanced system intelligence devices that will allow our underground and overhead

[3] 2016 South Carolina State Energy Plan, Appendices, Page 121.

assets to proactively report their condition status and potential problems before they manifest into equipment failures.

Q. HOW DO YOU EVALUATE RAPID TECHNOLOGY ADVANCEMENT PROGRAMS?

A. In this area of the Grid Improvement Plan, the Company looks for "enterprise" or system-level programs that enable interoperability and functionality to grid operations and thereby impact and provide value to all of our customers. A smart-thinking grid that can communicate and provide information to us and our customers and that can automatically react to grid events is essential to meet the demands of our customers and the implications of the Megatrends in South Carolina. Programs that can help the Company meet these requirements are selected for inclusion in this part of the Grid Improvement Plan. Since these programs are essential to enable a modern-functioning grid, the Company ensures that they are deployed and selected in a cost-effective manner.

Q. WHAT CONSTITUTES A SYSTEM OPTIMIZATION PROGRAM THAT IS PART OF THE FINAL CATEGORY OF WORK IN THE GRID IMPROVEMENT PLAN?

A. Programs and projects in this category provide customers more benefits than costs and solve for one or more of the external Megatrends that can have negative impacts to customers and grid operations. Work in this category spans a wide range of assets but primarily includes a "bundled combination" of Integrated Volt/Var Control ("IVVC"), Self-Optimizing Grid deployments,

and advanced power electronic systems that, when working together, provide optimum system performance for our customers. The Self-Optimizing Grid, also known as the smart-thinking grid, redesigns key portions of the distribution system and transforms it into a dynamic self-healing network that ensures any issue on the grid can be isolated and customer impacts are limited to hundreds versus thousands. These grid capabilities are enabled by installing automated switching devices to divide circuits into switchable segments that will serve to isolate faults and automatically reroute power around trouble areas which call for expanding line and substation capacity to allow for two-way power flow and creating tie points between circuits. The IVVC program leverages the grid improvements from the self-optimized grid and adds remotely-operated substation and distribution line devices such as regulator and capacitor controllable field devices that enable a grid operator to lower voltage as a way to reduce peak demand, thereby reducing the need to generate or purchase additional power at peak prices (peak shaving) or to operate in a conservation mode during periods of more typical electricity demand in order to reduce overall energy consumption and system losses.

Q. HOW DO YOU EVALUATE SYSTEM OPTIMIZATION PROGRAMS?

A. In selecting these programs for inclusion in the Grid Improvement Plan, the Company looks for programs that address the largest number of Megatrend implications at the lowest costs to customers. System optimization programs are justified by a qualitative and quantitative cost benefit analysis, and Exhibit 6 that I previously discussed provides more detail on how this is done at

various stages of program implementation. When a system-level program like IVVC[4] or Self-Optimizing Grid[5] is deployed throughout our service territory in South Carolina, the Company utilizes a program-level cost benefit analysis, and examples of this type of analysis are included in Exhibit 7 to my testimony. The Company also has a methodology for project-level cost benefit analysis which examines the costs and benefits of deploying a specific project solution based on the nature of a specific site. For example, the Targeted Undergrounding[6] and battery storage/micro-grid programs in the Grid Improvement Plan are evaluated on a site-by-site basis using project level cost benefit analyses. Examples of these sorts of analyses are also included in Exhibit 8.

Q. HOW HAS THE COMPANY SHAPED THIS COLLECTION OF PROGRAMS INTO A HOLISTIC GRID IMPROVEMENT PLAN?

A. Once the Company had selected the programs and projects that could meet customers' needs in the manner that I have previously discussed, the Company then had to develop a formal, year-over-year work plan that can be achieved given the resource constraints that I discussed earlier in my testimony.

[4] IVCC is particularly notable because it provides multiple benefits and savings to all our various customer classes while at the same time allowing the Company to have maximum flexibility to react to multiple system conditions on the grid.

[5] Self-Optimizing Grid is an example of investments with multiple layers of benefits as it helps customers save money in avoided system costs; allows more distributed energy resources (such as solar) to be on the grid; and provides containment and mitigation of outages by reducing thousands of impacted customers in an outage down to hundreds or less.

[6] Target Undergrounding is the process of burying certain lines for cost saving and reliability purposes, and not for aesthetic purposes, and could yield savings for all of our customers over what they would otherwise pay to maintain and repair and overhead system in addition to the improved reliability that it will provide.

Further, the final Grid Improvement Plan had to be developed not only in a risk-advised manner, but in a manner that is fair to all of our customers. For example, a Grid Improvement Plan that was too heavily weighted to address only one of the Megatrends impacting South Carolina could be viewed as short-sighted, while a Grid Improvement Plan that was too "diluted" and lacked strategic focus would be ineffective. Similarly, a Grid Improvement Plan that focused too heavily on one type or class of customer could be viewed as unfair. The Company had to balance all of these and other considerations when forming the final Grid Improvement Plan work.

Q. HOW DID DUKE ENERGY BALANCE DIVERSE CUSTOMER AND STAKEHOLDER NEEDS?

A. The Grid Improvement Plan for South Carolina is designed with programs that benefit all our customers, and that is one of the primary ways that we have balanced our customers' needs and interests. Over our three-year plan, we have also balanced the pace, scope, location, and timing of our work to ensure that customer and stakeholder needs are met. Further, we have kept the needs of our rural and low-income customers in mind as we developed our plan, and programs such as IVVC provide these customers both increases to reliability and resiliency while at the same time providing decreases in fuel costs, future capacity and carbon costs, and lower monthly energy usage.

Q. WHAT IS YOUR RESULTING GRID IMPROVEMENT PLAN FOR SOUTH CAROLINA?

A. After completing all the steps in our plan development process, we arrived at our Grid Improvement Plan, which is presented in Exhibit 9.

Q. HAVE YOU SHARED THE DETAILS OF THIS PLAN WITH INTERESTED STAKEHOLDERS IN SOUTH CAROLINA?

A. Yes, on August 14, 2018, the Company conducted a South Carolina stakeholder engagement workshop in Columbia that was led by a third-party facilitator, the Rocky Mountain Institute ("RMI"). During that workshop, the Company received input from multiple South Carolina stakeholders on grid improvement issues that are important to them. At the conclusion of that workshop, RMI prepared a detailed, post-workshop report reflecting the issues and questions raised by our customers and stakeholders, and I have included that report as Exhibit 10 to my testimony.

With the information and feedback that we received from that August 14, 2018 workshop, the Company then spent the next several weeks incorporating stakeholder input into the development of the proposed Grid Improvement Plan for South Carolina. On October 5, 2018, the Company sent a detailed "pre-read package" to South Carolina stakeholders describing the development and final proposed Grid Improvement Plan in advance of the next South Carolina stakeholder workshop. I have included that pre-read package as Exhibit 11.

On October 10, 2018, the Company held its second South Carolina stakeholder workshop in Columbia that was also facilitated by RMI. During that workshop, South Carolina customers and stakeholders were able to provide the Company detailed feedback on the proposed Grid Improvement Plan that the Company had provided as a pre-read in advance of the workshop, and the Company took note of several constructive comments and suggestions from workshop attendees. RMI similarly prepared a post-workshop report of that stakeholder meeting, and I have included it in my testimony as Exhibit 12.

Q. IN SUMMARY, WHAT CONCLUSIONS HAVE YOU DRAWN BASED ON ALL THE STEPS YOU TOOK TO DEVELOP THE GRID IMPROVEMENT PLAN?

A. I am confident that the South Carolina Grid Improvement Plan is well thought, properly balanced, and fairly developed by listening to and incorporating input from our South Carolina customers and stakeholders. I am also confident that the South Carolina plan is a reasonable and prudent choice for all our customers in South Carolina, and that fact is evidenced by the objective and clear benefits that it will provide.

Q. WHAT GRID IMPROVEMENT WORK HAS THE COMPANY DONE IN 2018 TO SUPPORT THE SOUTH CAROLINA GRID IMPROVEMENT PLAN?

A. In 2018, the Company has initiated and completed several foundational projects for the Grid Improvement Plan. Under the Self-Optimizing Grid program, the Company has installed reclosers that will form nine optimized self-healing networks in 2018 in Florence, Sumter, Darlington, Marion and Williamsburg counties. The 2018 work also included projects to provide back-feed connectivity and capacity for rural communities and business districts that experience long duration outages, and to improve sectionalization on distribution circuits to reduce the number of impacted customers during system events. The Transmission work includes (1) Hardening and Resiliency work (2) Transmission line resiliency work such as new line switches and (3) System Intelligence projects such as Condition Based Monitoring (CBM) installations. Also, the Company initiated "core" router and "edge" substation router communications replacements, and work continued for the replacement of 2G/3G cellular modems for distribution line devices with 4G and 5G modems, fiber optic cable, microwave, optical systems and system radio networks. Finally, enterprise system work included upgrades for "SCADA" and "DMS" system communications systems which are working toward delivery of new platforms by the end of 2019. All of these projects in 2018 are reasonable and prudent foundations of the South Carolina Grid Improvement Plan.

IV. RATE RECOVERY OF GRID IMPROVEMENT INVESTMENTS

Q. HAS THE COMPANY SOUGHT ANY ADDITIONAL RECOVERY METHODS FOR ONGOING COST FOR GRID IMPROVEMENTS?

A. Yes. The Company's application requests that the Commission approve our Grid Improvement Plan along with associated Phase 1 and Phase 2 rates. Witnesses Bateman, Wheeler, and Hager explain the details of the Company's prosposal for the recovery of Grid Improvement Plan costs.

Q. ARE YOU SPONSORING THE GRID IMPROVEMENT PLAN REFERENCED ABOVE?

A. Yes, and I have provided work plans for Commission approval in Exhibit 9, and I have provided the associated system level costs, both capital spend and operating and maintenance expense, to Witness Bateman for use in the development of the Phase 1 and Phase 2 rates being requested.

Q. IF THE COMMISSION APPROVES THE PHASE 1 AND PHASE 2 REQUESTED RATE CHANGES FOR GRID INVENSTMENTS, BASED ON THE PLANS SUBMITTED IN THIS CASE, WOULD THE PARTIES HAVE A CHANCE TO REVIEW THE WORK COMPLETED IN ADVANCE OF THE EFFECTIVE DATE OF NEW RATES?

A. Yes, the Company is willing to file quarterly status reports to apprise stakeholders of the progress made on the Grid Improvement Plan and our expenditures. The Company also commits to a 60-day audit, during which time the ORS and interested parties could review the costs we have incurred relative to the Grid Improvement Plan ultimately approved in this case in a

manner that is acceptable to ORS. We would file that information for the prior year for auditing purposes by March 1, 2020 and March 1, 2021, as explained in further detail by Witness Bateman.

Q. IF APPROVED, WOULD THE COMPANY AGREE TO PUT FORTH THE SAME INFORMATION FOR FUTURE YEARS?

A. Yes. The Company envisions that the expenditures not established in this case would be brought back before the Commission through a process like this one for similar treatment.

Q. DO YOU INTEND, THROUGH THIS PROCESS, TO CONTINUE THE SC GRID IMPROVEMENT WORKSHOPS AND ENGAGE WITH PARTICIPATING STAKEHOLDERS THROUGH THE NEXT SEVERAL YEARS?

A. Yes. Our grid improvement needs and planning process span multiple years, and we expect to have continuing dialogue with interested parties on those plans and how it benefits and affects those interested parties and to continue to bring those findings to the Commission in the form of future requests.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.